

Claims

[c1] What is claimed is:

1.A system for detecting non-repeating defects in a light-management film, the film having a first side and a second side, comprising:

a first light source configured to emit light onto the first side of the film in a first predetermined region of the film;

a second light source configured to emit light onto the second side of the film in the first predetermined region of the film;

a first camera configured to receive a first portion of light reflected from the first predetermined region of film from the first light source and a second portion of the light propagating through the film from the second light source; and

a signal-processing device operably coupled to the first camera configured to detect a defect in the first predetermined region of the film based on at least one of the first and second portions of light.

[c2] 2.The system of claim 1, wherein the first camera is disposed at least partially within a first conically shaped re-

gion, the first conically shaped region extending from the first predetermined region of film outwardly from the first side and having an apex proximate the first predetermined region, the first conically shaped region being centered about an axis, the axis extending through the first predetermined region of film generally perpendicular to the film, the first conically shaped region extending around the axis at a predetermined angle.

[c3] 3.The system of claim 2, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c4] 4.The system of claim 2, wherein the second light source is disposed at least partially within a second conically shaped region, the second conically shaped region extending from the first predetermined region of film outwardly from the second side and having an apex proximate the first predetermined region, the second conically shaped region being centered about the axis, the second conically shaped region extending around the axis at the predetermined angle.

[c5] 5.The system of claim 4, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c6] 6.The system of claim 4, wherein the first light source is disposed at least partially within a third conically shaped

region, the third conically shaped region extending from the first predetermined region of film outwardly from the first side and having an apex proximate the first predetermined region, the third conically shaped region being centered about the axis, the third conically shaped region extending around the axis at a second angle.

- [c7] 7.The system of claim 6, wherein the second angle is within a range of 0 to 60 degrees.
- [c8] 8.The system of claim 1, wherein the defect comprises a non-repeating defect on the light-management film.
- [c9] 9.The system of claim 8, wherein the signal-processing device detects the non-repeating defect in the first predetermined region of the film based on both the first and second portions of light.
- [c10] 10.The system of claim 1, wherein the defect comprises a repeating defect on the light-management film.
- [c11] 11.The system of claim 1, wherein the first camera comprises a CCD camera.
- [c12] 12.The system of claim 1, wherein the first and second light sources and the first camera are oriented toward the first predetermined location.
- [c13] 13.The system of claim 1, wherein the first camera is out

of focus a predetermined amount.

[c14] 14. The system of claim 1, further comprising:
a third light source configured to emit light onto the second side in a second predetermined region of the film;
a fourth light source configured to emit light onto the first side of the light-management film in the second predetermined region of the film; and
a second camera configured to receive a third portion of light reflected from the second predetermined region of film from the third light source and a fourth portion of the light propagating through the film from the fourth light source, the signal-processing device operably coupled to the second camera, the signal-processing device being configured to detect a defect in the second predetermined region of the film based on at least one of the third and fourth portions of light.

[c15] 15. The system of claim 1, wherein the second camera is disposed at least partially within a first conically shaped region, the first conically shaped region extending from the second predetermined region of film outwardly from the second side and having an apex proximate the second predetermined region, the first conically shaped region being centered about an axis, the axis extending through the second predetermined region of film gener-

ally perpendicular to the film, the first conically shaped region extending around the axis at a predetermined angle.

[c16] 16.The system of claim 15, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c17] 17.The system of claim 15, wherein the fourth light source is disposed at least partially within a second conically shaped region, the second conically shaped region extending from the second predetermined region of film outwardly from the first side and having an apex proximate the second predetermined region, the second conically shaped region being centered about the axis, the second conically shaped region extending around the axis at the predetermined angle.

[c18] 18.The system of claim 17, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c19] 19.The system of claim 17, wherein the third light source is disposed at least partially within a third conically shaped region, the third conically shaped region extending from the second predetermined region of film outwardly from the second side and having an apex proximate the second predetermined region, the third conically shaped region being centered about the axis, the

third conically shaped region extending around the axis at a second angle.

[c20] 20.The system of claim 19, wherein the second angle is within a range of 0 to 60 degrees.

[c21] 21.A method for detecting non-repeating defects in a light-management film having a first side and a second side, the method comprising:
emitting light from a first light source onto the first side of the film in a first predetermined region of the film;
emitting light from a second light source onto the second side of the light-management film in the first predetermined region of the film; and
detecting a defect in the film based on at least one of a first portion of the light reflected from the first predetermined region of film from the first light source and a second portion of the light propagating through the film from the second light source.

[c22] 22.The method of claim 21, wherein the defect comprises a non-repeating defect, the non-repeating defect being detected using both the first and second portions of light.

[c23] 23.The method of claim 21, wherein the defect comprises a repeating defect, the repeating defect being de-

tected using at least one of the first and second portions of light.

[c24] 24. The method of claim 21, further comprising:
generating a first digital image from the first portion of the light reflected from the first predetermined region of film from the first light source;
generating a second digital image from the second portion of the light propagating through the film from the second light source;
summing the first and second digital images to obtain a summed image; and
detecting the defect in the film based on the summed image.

[c25] 25. A system for detecting repeating defects in a light-management film, the film having a first side and a second side, comprising:
first and second light sources configured to emit light onto the first and second sides, respectively, of the film;
a first camera disposed adjacent the first side of the film proximate the first light source that receives transmissive and reflected light from the film and generates a first plurality of digital images of the film covering a first region of the film to a second region of the film as the film moves in an axial direction;
third and fourth light sources configured to emit light

onto the first and second sides, respectively, of the film, the third light source emitting light during a first predetermined time period when the fourth light source is not emitting light, the fourth light source emitting light during a second predetermined time period after the first predetermined time period when the third light source is not emitting light;

a second camera disposed adjacent the second side of the film proximate the fourth light source that receives either transmissive or reflected light from the film and generates a second plurality of digital images of the film covering the first region of the film to the second region of the film as the film moves in the axial direction; and a signal-processing device operably coupled to the first and second cameras configured to detect the repeating defect in the film based on the first and second plurality of digital images.

[c26] 26. The system of claim 25, wherein the first camera is disposed at least partially within a first conically shaped region, the first conically shaped region extending from the first predetermined region of film outwardly from the first side and having an apex proximate the first predetermined region, the first conically shaped region being centered about a first axis, the axis extending through the first predetermined region of film generally perpen-

dicular to the film, the first conically shaped region extending around the first axis at a predetermined angle.

[c27] 27.The system of claim 26, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c28] 28.The system of claim 26, wherein the second light source is disposed at least partially within a second conically shaped region, the second conically shaped region extending from the first predetermined region of film outwardly from the second side and having an apex proximate the first predetermined region, the second conically shaped region being centered about the first axis, the second conically shaped region extending around the first axis at the predetermined angle.

[c29] 29.The system of claim 28, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c30] 30.The system of claim 28, wherein the first light source is disposed at least partially within a third conically shaped region, the third conically shaped region extending from the first predetermined region of film outwardly from the first side and having an apex proximate the first predetermined region, the third conically shaped region being centered about the first axis, the third conically shaped region extending around the first axis at a

second angle.

[c31] 31.The system of claim 30, wherein the second angle is within a range of 0 to 60 degrees.

[c32] 32.A method for detecting repeating defects in a light-management film having a first side and a second side, the method comprising:
moving the film past first and second light sources disposed proximate the first and second sides, respectively, of the film;
emitting light from the first and second light sources onto the first and second sides, respectively, of the film;
generating a first plurality of digital images of the film covering a first region of the film to a second region of the film using a first camera disposed adjacent the first side of the film that receives transmissive and reflected light from the film;
moving the film past third and fourth light sources disposed proximate the first and second sides, respectively, of the film;
emitting light from the third light source onto the first side for a first predetermined time period while not emitting light from the fourth light source and then emitting light from the fourth light source onto the second side for a second predetermined time period while not emitting light from the third light source;

generating a second plurality of digital images of the film covering the first region of the film to the second region of the film using a second camera disposed adjacent the second side of the film that receives either transmissive or reflected light from the film; and detecting a repeating defect in the film based on the first and second plurality of digital images.

[c33] 33. The method of claim 32, wherein detecting the repeating defect comprises:
summing each of the first plurality of digital images with a corresponding image of the second plurality of digital images to obtain a summed digital image of the first region to the second region of the film;
detecting first, second, and third defects using the summed digital image and storing first, second, and third coordinates associated with the first, second, and third defects, respectively, in a memory; and
determining that the repeating defect is present when an axial distance between the first and second coordinates is substantially equal to an axial distance between the second and third coordinates.

[c34] 34. The method of claim 32, wherein the first camera is disposed at least partially within a first conically shaped region, the first conically shaped region extending from the first predetermined region of film outwardly from the

first side and having an apex proximate the first predetermined region, the first conically shaped region being centered about a first axis, the axis extending through the first predetermined region of film generally perpendicular to the film, the first conically shaped region extending around the first axis at a predetermined angle.

[c35] 35.The method of claim 33, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c36] 36.The method of claim 34, wherein the second light source is disposed at least partially within a second conically shaped region, the second conically shaped region extending from the first predetermined region of film outwardly from the second side and having an apex proximate the first predetermined region, the second conically shaped region being centered about the first axis, the second conically shaped region extending around the first axis at the predetermined angle.

[c37] 37.The method of claim 36, wherein the predetermined angle is within a range of 0 to 60 degrees.

[c38] 38.The method of claim 36, wherein the first light source is disposed at least partially within a third conically shaped region, the third conically shaped region extending from the first predetermined region of film outwardly

from the first side and having an apex proximate the first predetermined region, the third conically shaped region being centered about the first axis, the third conically shaped region extending around the first axis at a second angle.

[c39] 39. The method of claim 38, wherein the second angle is within a range of 0 to 60 degrees.